

**CLAIMS**

- 1    1.    A method of determining resistance in a fuel cell, including the steps of:
  - 2            (A)    measuring an initial stack current and stack voltage;
  - 3            (B)    changing fuel cell stack load across the fuel cell;
  - 4            (C)    substantially immediately reading the output voltage and current of the
  - 5                      fuel cell; and
  - 6            (D)    calculating the resistance of the fuel cell.
  
- 1    2.    The method of determining resistance in a fuel cell, as defined in claim 1,
  - 2            including the further steps of:
  - 3            (A)    coupling constant current with the fuel cell to set stack current;
  - 4            (B)    waiting a predetermined time period for the output voltage of the fuel
  - 5                      cell to stabilize;
  - 6            (C)    measuring the output voltage of the fuel cell;
  - 7            (D)    changing the fuel cell current;
  - 8            (E)    substantially immediately reading the output voltage of the fuel cell; and
  - 9            (F)    calculating the resistance of the fuel cell.
  
- 1    3.    The method of determining resistance, as defined in claim 2 including the
  - 2            further step of
  - 3                      evaluating any changes in said calculated resistance over time as a measure of
  - 4            fuel cell hydration.

1 4. The method of determining resistance in a fuel cell, as defined in claim 1,  
2 including the further steps of:  
3 (A) switching a fixed resistance load onto said fuel cell;  
4 (B) allowing the fuel cell stack voltage to stabilize at a first voltage level;  
5 (C) removing the fixed resistance;  
6 (D) substantially immediately measuring the new stack voltage; and  
7 (E) calculating the fuel cell resistance based upon the change between the  
8 first voltage level and the new stack voltage.

1 5. The method of determining resistance as defined in claim 1 including the further  
2 steps of:  
3 (A) providing a DC-DC converter with an associated microcontroller;  
4 (B) adjusting input parameters of said DC-DC converter, using said  
5 microcontroller, to establish an initial duty cycle;  
6 (C) reading the stack voltage and the stack current;  
7 (D) charging the duty cycle;  
8 (E) substantially immediately measuring the fuel cell voltage and fuel cell  
9 current; and  
10 (F) calculating resistance based upon measurements.

1 6. The method of determining resistance, as defined in claim 1 including the  
2 further step of

3                   evaluating any changes in resistance over time as a measure of fuel cell  
4                   hydration.

1     7.     The method of determining resistance, as defined in claim 1, wherein said fuel  
2     cell comprises one of the following:

- 3           (A)    a fuel cell stack;  
4           (B)    a fuel cell array; and  
5           (C)    an individual fuel cell.

1     8.     The method of determining resistance, as defined in claim 3, wherein a fuel cell  
2     in said fuel cell stack, said fuel cell array, or said individual fuel cell is a direct  
3     oxidation fuel cell.

1     9.     The method of determining resistance, as defined in claim 4, wherein said direct  
2     oxidation fuel cell is a direct methanol fuel cell.

1     10.    The method of determining resistance, as defined in claim 3, wherein a fuel cell  
2     in said fuel cell stack, said fuel cell array, or said individual fuel cell is a hydrogen fuel  
3     cell.

1 11. A system of measuring resistance of a fuel cell means, comprising:

2 (A) a fuel cell means which generates an output voltage and an output  
3 current;

4 (B) a fixed load circuit connected in parallel with said fuel cell means  
5 responsive to a control signal for switching said fixed load circuit across said fuel cell  
6 means; and

7 (C) a measuring device coupled to said fuel cell that measures desired  
8 parameters related to the resistance across the fuel cell means.

1 12. The system as in claim 11 wherein said fuel cell means is a direct oxidation fuel  
2 cell stack.

1 13 The system as in claim 11 wherein said fuel cell means is a direct oxidation fuel  
2 cell array.

1 14. The system as in claim 11 further comprising a DC-DC converter circuit having  
2 input that is connected to receive the output voltage from said fuel cell means and being  
3 responsive to said control signal for varying the opening and closing of switches within  
4 said DC-DC converter such that a load is switched on and off said fuel cell means and  
5 said measuring device has means for measuring the resistance of the fuel cell means,  
6 when said switches are turned on, and when turned off.

1 15. A method of measuring resistance in a fuel cell stack being used as a power  
2 source, comprising the steps of:

- 3           (A)    using a fuel cell stack to produce power that can be supplied to a battery
- 4    or load;
- 5           (B)    switching a fixed load across said fuel cell stack;
- 6           (C)    reading the voltage across the stack after a predetermined time period
- 7    when said fixed load circuit is on;
- 8           (D)    turning off the load;
- 9           (E)    substantially immediately reading the stack voltage; and
- 10          (F)    determining stack resistance based upon a change in said stack voltage
- 11   readings.

1   16.    A method of measuring resistance across a direct oxidation fuel cell stack that  
2   includes programmable DC-DC switches including the steps of:

- 3           (A)    using said programmable DC-DC switches to switch a load on and off
- 4    said fuel cell stack;
- 5           (B)    signaling an associated microprocessor under pulse-width modulation
- 6    control to adjust the duty cycle of said DC-DC switches
- 7           (C)    measuring voltage changes as said switches change;
- 8           (D)    calculating a change in resistance over time; and
- 9           (E)    predicting cell hydration based upon said changes.